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AUTHORITY

USATEC ltr, 14 Dec 1970

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AD 868557

26 November 1969

Materiel Test Procedure 7-2-105
General Equipment Test Activity

U. S. ARMY TEST AND EVALUATION COMMAND
COMMODITY ENGINEERING TEST PROCEDURE

TRACTOR, WHEELED, AIRCRAFT, TOWING

1. OBJECTIVE*

This document provides test methodology and techniques necessary to determine the technical performance and safety characteristics of wheeled aircraft towing tractors and associated tools and equipment as described in Qualitative Materiel Requirements (QMR's), Small Development Requirements (SDR's), Technical Characteristics (TC's), as indicated by the particular design and to determine the technical suitability of the item for service test.

2. BACKGROUND

Requirements exist for wheeled, tractor vehicles powered by diesel or gasoline internal combustion engines suitable for towing aircraft and other aeronautical equipment in all types of weather on concrete, sand, clay, or rough terrain surfaces.

These wheeled tractors are required in a variety of capacities, typically ranging from drawbar pull values of 4,000 to 75,000 pounds. In general, the tractors are to have a short, compact wheel base suitable for maneuvering in restricted areas in addition to a low-profile style design to facilitate operation in and around parked aircraft.

Certain tractors will be required to contain systems for starting jet or reciprocating engines and/or facilities for providing total aircraft electrical power requirements. Also, tractors will normally be required to carry fire extinguishers, provide winch services, and contain storage space for tools and chock-blocks.

All wheeled aircraft towing tractors are required to be of rugged construction and of a design essentially free of interference or obstructions to aircraft servicing.

3. REQUIRED EQUIPMENT

- a. POL Materials.
- b. Stop Watch.
- c. Inclinometer.
- d. Pressure Gauges.
- e. Measuring Tapes.
- f. Pressure-Type Indicating Device/Gauge suitable for attachment to test item clutch pedal.

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- g. Meteorological Instruments.
- h. Adapter Pulley with diameter equal to test item hand steering wheel diameter.
- i. Tension Dynamometer.
- j. Platform Scale.
- k. Steel Cable; Chain; Hooks (for lifting attachment test and drawbar pull test).
- l. Photoelectric Switches and Timing Device (electronic).
- m. Materials for obstacle block construction.
- n. Trailing Load(s) for test item (equal in gross weight to ten times rated drawbar pull value).
- o. Maintenance and Inspection Facilities.
- p. Laboratory and/or Bench Testing Facilities, as required.
- q. Endurance and Durability Test Course, as described in Appendix A.
- r. Equipment and Facilities as described in referenced MTP's.

4. REFERENCES

- A. USATECOM Regulation 385-6, Verification of Safety of Materiel During Testing.
- B. USATECOM Regulation 700-1, Value Engineering.
- C. USATECOM Regulation 705-4, Equipment Performance Report.
- D. MIL-STD-129, Marking for Shipment and Storage.
- E. MIL-STD-130, Identification Marking of U. S. Military Property.
- F. MIL-STD-259C, Test and Inspection of Tractor, Wheeled, Warehouse.
- G. MIL-STD-461, Electromagnetic Interference Characteristics Requirements for Equipment.
- H. MIL-STD-462, Electromagnetic Interference Characteristics Measurements of.
- I. MIL-STD-463, Definitions and System of Units, Electromagnetic Interference Technology.
- J. MIL-STD-1472, Human Engineering Design Criteria for Military Systems, Equipment and Facilities.
- K. MIL-E-11275, Engines, Gasoline, Industrial Type, General Specifications for.
- L. MIL-T-46729, Tire, Pneumatic, for Military Ground Vehicles.
- M. USAGETA Document, Human Factors Evaluation Data for General Equipment (HEDGE).
- N. Underwriter's Laboratories, Inc. UL558: Standards for Safety of Internal Combustion Engine - Powered Industrial Trucks.
- O. AR 70-38, Research, Development, Test, and Evaluation of Materiel for Extreme Climatic Conditions.
- P. HEL-STD-S-1-63B, Maximum Noise Level for AMC Equipment.
- Q. TB MED 251, Noise and Conservation of Hearing.
- R. MTP 2-2-500, Vehicle Characteristics.
- S. MTP 2-2-502, Inspection (Automotive).
- T. MTP 2-2-503, Maintenance.
- U. MTP 2-2-505, Preliminary Operation.
- V. MTP 2-2-508, Safety Evaluation (Automotive).
- W. MTP 2-2-520, Logistics-Over-The-Shore (LOTS).
- X. MTP 2-2-601, Electrical Systems (Automotive).

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- Y. MTP 2-2-602, Acceleration: Maximum & Minimum Speeds.
- Z. MTP 2-2-603, Vehicle Fuel Consumption.
- AA. MTP 2-2-604, Drawbar Pull.
- AB. MTP 2-2-605, Towing Resistance.
- AC. MTP 2-2-607, Engine and Power Train Systems Cooling (Vehicle).
- AD. MTP 2-2-608, Braking, Wheeled Vehicle.
- AE. MTP 2-2-609, Steering.
- AF. MTP 2-2-610, Gradeability & Side Slope Performance Mobility.
- AG. MTP 2-2-612, Fording.
- AH. MTP 2-2-614, Carbon Monoxide Hazards Test for Vehicles.
- AI. MTP 2-2-619, Off-Road Vehicle Mobility Test.
- AJ. MTP 2-2-650, Cold Starting and Warm-up.
- AK. MTP 2-2-700, Laboratory Tests of Reciprocating Internal Combustion Engines.
- AL. MTP 2-2-703, Laboratory Tests of Power Train Components.
- AM. MTP 2-2-704, Tires.
- AN. MTP 2-2-707, Kits (Vehicle).
- AO. MTP 2-2-708, Personnel Heating Systems.
- AP. MTP 2-2-712, Automotive Winches.
- AQ. MTP 2-2-800, Center of Gravity.
- AR. MTP 2-2-802, Stowage.
- AS. MTP 2-2-803, Human Factors Engineering (Vehicles).
- AT. MTP 7-2-515, Air Transport (Suitability of Equipment for).
- AU. MTP 9-2-136, Generating and Charging Plants.
- AV. MTP 9-2-166, Air Compressor.
- AW. MTP 10-2-501, Operator Training and Familiarization.
- AX. MTP 10-2-503, Surface Transportability (General Supplies and Equipment).
- AY. MTP 10-2-508, Safety.

5. SCOPE

5.1 SUMMARY

This procedure describes the preparation for and methods of evaluating the technical characteristics of wheeled aircraft towing tractors and their suitability for service testing. The required tests are summarized as follows:

- a. Preparation for Test - A determination of the condition and physical characteristics of the test item upon arrival, to ensure that the test item is complete and functionally operational, determination of the performance and endurance of the test item major components and to provide operator training and familiarization procedures.
- b. Subsystem tests - These procedures provide for the testing of test item components/assemblies/subassemblies which do not require tractor disassembly or component bench testing. The following individual tests are included:

- 1) Clutch Pedal Test.
- 2) Steering Wheel Test.
- 3) Brake Tests.
- 4) Electrical System Test.

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- 5) Cooling System Test
- 6) Exhaust System Tests
- 7) Accessory Tests
- 8) Power-Train Tests

c. Overall Tractor Performance Tests - These procedures provide for the testing of the test item as a unit or system. The following tests are performed:

- 1) Drawbar Pull Test
- 2) Acceleration-Acceleration Response Test
- 3) Speed Test
- 4) Fuel Consumption Test
- 5) Turning Radius Test
- 6) Gradeability and Side Slope Performance Test
- 7) Fording Test
- 8) Mobility Test
- 9) Endurance and Durability Test
- 10) Broadband Radio Interference Test
- 11) Magnetic Permeability Property Test

d. Transportability - An evaluation to determine the ability of the test item to withstand the forces which it will experience during normal handling and transportation.

e. Maintenance - An evaluation to determine and appraise the test item's maintenance characteristics and requirements, a verification and appraisal of its malfunctions, an evaluation of the test item's associated publications and other common and special support elements (maintenance test package), an appraisal of the test item's design for maintainability (AMCP 706-134; accessibility, ease of maintenance, standardization, and interchangeability), an evaluation of component and system durability and reliability, and the calculation of indicators which express the effects of appropriate preceding aspects.

f. Safety - An evaluation to determine the safety characteristics and possible hazards of the test item and to provide information for a safety release.

g. Human Factors Evaluation - An evaluation to determine the adequacy of the design and performance characteristics of the test item and associated equipment in terms of conformance to accepted human factors engineering design criteria.

h. Value Analysis - An evaluation directed at analyzing the primary function and features of the test item for the purpose of reducing the cost of the test item without compromising performance and safety characteristics.

5.2 LIMITATIONS

None

6. PROCEDURES

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6.1 PREPARATION FOR TEST

6.1.1 Initial Inspection

Upon receipt of the test item at the test site, perform applicable procedures of MTP 2-2-502 and the following:

a. Visually inspect the assembled test item, including the blocking, crating, or other materials used for rail shipment. Record the following:

- 1) Evidence of damage or deterioration of test item or materials used for protection during shipment.
- 2) Identification markings which were not in accordance with MIL-STD-129, MIL-STD-130, or test item detail specification.

b. Remove test item from the carrier; unpack and remove all traces of protective transport/storage materials. When this has been accomplished, visually inspect the test item. Record evidence of defects in the following areas:

- 1) Manufacturing
- 2) Material
- 3) Workmanship

6.1.2 Inventory Check

a. Conduct an inventory against the Basic Issue Items List (BIIL). Record evidence of the following:

- 1) Missing maintenance literature or draft technical manuals.
- 2) Shortages in repair parts, accessories, or tools.
- 3) Missing kits.
- 4) Missing parts, tools, or other components of the maintenance package.

b. Submit an Equipment Performance Report (EPR) for each noted shortage or discrepancy.

6.1.3 Inspection and Preliminary Operation

a. Perform periodic inspection(s) and maintenance as required by the draft technical manual and in accordance with applicable procedures of MTP 2-2-502.

b. Establish that the actual test item serial number and engine identification number match those numbers which appear on records accompanying the test item.

c. Read the test item running-time meter; if the total elapsed operating time is less than four hours, or less than an otherwise specified elapsed time, subject the test item to the break-in procedures of MTP 2-2-505.

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6.1.4 Pre-Test Evaluations

Determine the performance and endurance of wheeled aircraft towing tractor's major components and the suitability of testing the tractor as a system by performing the following:

6.1.4.1 Reciprocating Internal Combustion Engine Tests

Subject the test item engine type to the procedures of MTP 2-2-700 and the selection criteria of MIL-E-11275.

6.1.4.2 Power Train Component Tests

Subject test item power train components (clutch, transmission, transfer case, drive shaft, differential, axles, and brakes) to the procedures of MTP 2-2-703.

6.1.4.3 Tire Tests (For new makes of tires only)

Subject test item tire type(s) to the procedures of MTP 2-2-704 and the selection criteria of MIL-T-46729.

6.1.5 Physical Characteristics

a. Determine the physical characteristics of the test item as described in the applicable portions of the general, design and physical data sections of MTP 2-2-500, with emphasis on the following:

- 1) Engine make and model
- 2) Test item length, less coupler(s)
- 3) Width
- 4) Height, less cab
- 5) Wheelbase
- 6) Ground clearance
- 7) Governed speed
- 8) Gross vehicle weight

b. Determine and record the following:

- 1) Counterweight information, e.g., removable, weight, etc.
- 2) Drive-steer provisions, e.g., two wheel drive, two wheel steer, etc.
3. Aircraft service facilities provided, e.g., starting compressor, etc.
4. Safety equipment supplied.

c. Determine the vertical and horizontal center of gravity as measured from the drive axle, by utilization of applicable procedures of MTP 2-2-800.

6.1.6 Operator Training and Familiarization

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Train test personnel in accordance with the applicable procedures of MTP 10-2-501 and record all pertinent data.

6.2 TEST CONDUCT

NOTE: All equipment failures shall be reported in accordance with USATECOM Regulation 705-4.

6.2.1 Subsystem Tests

Test the following components/assemblies/subassemblies without dis-assembling the test item:

6.2.1.1 Clutch Pedal Test

To determine the force required to depress the test item clutch pedal, proceed as follows:

- a. Obtain a scale indicating device (pressure type) or the equivalent, which is suitable for attaching to the test item clutch pedal.
- b. Thermally stabilize the test item at standard ambient temperature. Record the temperature.
- c. With the tractor engine not running, depress the clutch pedal several times to insure proper lubrication.
- d. Attach the indicating device to the clutch pedal.
- e. Apply pressure slowly and evenly until the clutch pedal is depressed to within one inch of the floor plate. Record the maximum gauge reading.
- f. Start the tractor engine; allow for a fifteen minute warm-up period.
- g. Place the gear shift in the neutral position.
- h. Repeat procedural steps d and e. In addition to the maximum gauge reading, record any indication of altered clutch pedal operating characteristics.

6.2.1.2 Steering Wheel Test

Determine test item steering wheel characteristics of performance in accordance with MTP 2-2-609 and the following:

- a. Place the tractor on a dry, level, brushed concrete surface with the steer wheels set in a straight ahead position.
- b. Thermally stabilize the test item at standard ambient temperature. Record the temperature value.
- c. Attach an adapter pulley having a root diameter equal to the steering wheel diameter, to the spokes of the hand steering wheel.
- d. Apply a steady force to a dynamometer attached to the adapter pulley in a counter-clockwise direction and in the wheel plane, until the wheel turns.
- e. Record the maximum gauge reading at extreme ends of the steer range.
- f. Perform the procedures of steps d and e in a clockwise direction.

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In addition to the gauge reading, record any indication of altered steering wheel operating characteristics.

g. Raise the tractor front end until the front wheels clear the surface. Block the test item in this position.

h. Lock one front steerable wheel in a straight ahead position.

i. Apply, through a tension dynamometer in a clockwise direction, the specified force. (Conventional manual or power-boosted steering).

NOTE: When all hydraulic steering is used, the relief valve should be made inoperative. Also, the specified force should be applied with tractor power off.

j. Repeat the procedures of step i four times and record whether or not steering mechanism and hydraulic linkages were able to withstand the applied force without evidence of failure or permanent deformation.

k. Repeat the procedures of steps i and j for the counter clockwise direction.

l. Remove test apparatus, un-block and lower the tractor to the level, brushed concrete surface.

m. Turn the steering wheel such that the steer wheels are at an extreme left position.

n. Measure and record the number of turns of the hand steering wheel required to turn the steer wheels from the extreme left position to the extreme right position.

o. Repeat the procedures of steps m and n, beginning with the steer wheels set to extreme right.

6.2.1.3 Brake Tests

Determine the performance characteristics of test item service and parking brakes in accordance with MTP 2-2-608 and the following:

a. Place the test item on a dry, level, brushed concrete surface.

NOTE: If the surface friction between the concrete and tractor tires is less than 0.50, the surface may be brushed with abrasion compound or other material to provide a 0.90 coefficient of friction.

b. Thermally stabilize the test item at standard ambient temperature. Record the temperature value.

c. Attach a suitable pressure gauge to the test item brake pedal in a manner which will enable pressure to be applied to the face of the gauge.

d. Attach a tension dynamometer to the tractor pintle hook.

e. Attach one end of a block and tackle, or similar mechanical device to the tension dynamometer, and the other end to an anchoring device.

f. Pull the tractor with a suitable vehicle over the specified surface with the engine disengaged and parking brake released.

g. Apply sufficient brake pedal pressure to produce a force recorded on the dynamometer equal to specified percent of ultimate drawbar pull. Record this attained value.

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h. Gradually reduce the brake pedal pressure until the tractor wheels just begin to turn while maintaining tension on the dynamometer. Record brake pedal pressure and dynamometer readings.

i. Repeat the procedures of steps d through h with the dynamometer attached to the front of the test item.

j. Fully engage test item parking brake and repeat the procedure on steps f and g. Record whether or not the parking brake meets the prescribed performance.

6.2.1.4 Electrical System Tests

Perform the applicable procedures of MTP 2-2-601.

6.2.1.5 Cooling System Tests

Perform the applicable procedures of MTP 2-2-607.

6.2.1.6 Exhaust System Tests

Subject test item exhaust to the procedures of MTP 2-2-614.

6.2.1.7 Accessory Tests

6.2.1.7.1 Lifting Attachment Test - Determine whether or not test item lifting eyes comply with the specified requirements, by performing the following:

a. Weigh test item on suitable platform scales and record the weight.
b. Weigh tractor with rear wheels only on the scale and record the weight.

c. Measure the horizontal perpendicular distance from the center of the rear lifting eye to the vertical plane passing through the center of the front lifting eye and record the distance.

NOTE: Use front and rear lifting eyes, on same side of tractor.

d. Measure the horizontal perpendicular distance from center of the front lifting eye to the vertical plane passing through the axis of the front wheels. Record this distance as a positive value when lifting eyes are forward, and as negative when the lifting eyes are rearward, of the forward wheels.

e. Secure the tractor to the floor/surface.

f. Apply a vertical force equal to four times the computed normal vertical force on a rear eye or the force equal to weight of tractor, whichever is greater. The force should be applied through a tension dynamometer with the cable attached to the lifting eye such that the force applied is in a true vertical direction.

g. Repeat procedural step f for front lifting eyes. Use four times the computed normal vertical force on a front eye or the force equal to weight of tractor, whichever is greater.

h. Examine the lifting eyes and the points at which they are attached to the test item. Record evidence of permanent deformation, fractures or other signs of failure.

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6.2.1.7.2 Kit Evaluation - Evaluate kits in accordance with MTP 2-2-707.

6.2.1.7.3 Personnel Heating and Ventilation System Evaluation - Perform the applicable procedures of MTP 2-2-708.

6.2.1.7.4 Winch Evaluation - Perform the applicable procedures of MTP 2-2-712.

6.2.1.7.5 Generator Test - If the test item is equipped with a generator to supply aircraft with electrical power, subject the generator to the applicable procedures of MTP 9-2-136.

6.2.1.7.6 Compressor Test - If the test item is equipped with a compressor for starting aircraft engines, subject the compressor to the applicable procedures of MTP 9-2-166.

6.2.1.7.7 Stowage - Determine the adequacy of storage space provided for tools and chock-blocks as directed in the applicable sections of MTP 2-2-802.

6.2.1.8 Power-Train Test

Perform applicable procedures of MTP 2-2-605.

6.2.2 Overall Tractor Performance Tests

Test the aircraft towing tractor as a unit or system by performing the following:

6.2.2.1 Drawbar Pull Test

Determine whether the tractor being evaluated meets the ultimate drawbar pull requirement, by performing the applicable procedures of MTP 2-2-604 and the following:

a. Place the test item on a dry, level, brushed concrete surface.

NOTE: If the surface friction between the concrete and tractor tires is less than 0.50, the surface may be brushed with abrasion compound or other material to provide a 0.90 coefficient of friction.

b. Thermally stabilize the test item at standard ambient temperature and record the temperature.

c. Measure and record barometric pressure at time of test and record test site altitude.

d. Attach the tractor pintle hook to an anchor of sufficient strength to withstand a force equal to ten times the test item rated drawbar pull value. This connection is made with sections of steel cable or chain in series with a dynamometer.

NOTE: The cable or chain anchor connection point should be at the same height as the test items pintle hook connection.

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- e. Inflate test item tires, with air only, to the specified or recommended pressure.
- f. Start and warm-up the tractor engine for fifteen minutes.
- g. Start tractor forward in low gear and slowly accelerate until the dynamometer gauge reads maximum. Record the maximum drawbar pull value attained.
- h. Repeat step g. five times, with each operation separated by at least one hour.
- i. If the test item did not attain the minimum specified drawbar pull value, record observations of test team members as to why the test item failed.

6.2.2.2 Acceleration-Acceleration Response Test

Determine the acceleration characteristics of the test item, by performing the applicable procedures of MTP 2-2-602 and the following:

- a. Place the test item on a dry, level, brushed concrete surface.
- b. Mark-off on the test surface an interval, "A-B", of specified length for acceleration tests.
- c. Warm-up the tractor engine for fifteen minutes prior to testing.
- d. Locate the unloaded tractor with its front wheels at point "A".
- e. Locate at point "A" and at point "B" photoelectric switches which are connected to a recently calibrated electronic timing device.
- f. With the tractor engine running at idle speed, the transmission engaged, and the operator alerted, accelerate the test item at the maximum attainable speed from point "A" to point "B". Record the elapsed time.
- g. Repeat step f. five times.
- h. Load the test item pintle with the rated trailing load. Repeat the procedures of steps f. and g.
- i. Place the test item with specified rated trailing load on level surfaces with the engine running at idle speed, the transmission in low-speed, forward drive and the clutch shall be disengaged.
- j. Arrange a timing device to be started simultaneously with the engagement of the clutch.
- k. At a pre-arranged signal, the test item operator shall depress the accelerator/engage the clutch (and start the timing device).
- l. Observe the tractor closely. At the instant of tractor movement, the timing device shall be stopped and the elapsed time shall be recorded.
- m. Repeat the procedures of steps k. and l. five times.
- n. Repeat the procedures of steps k., l., and m. for no-load conditions.

6.2.2.3 Speed Test

Determine test item attainable speed on a level surface over a measured distance, by performing the applicable procedures of MTP 2-2-602 and the following:

- a. Place the test item on a dry, level, brushed concrete surface.
- b. Mark-off on the test surface three points, "A", "B", and "C".

The interval of "A-B" shall be equal to the distance required for the test item

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to achieve maximum velocity; the interval "B-C" shall be equal to eighty-eight feet. An automatic photoelectric timing device is connected to switches located at points "B" and "C".

NOTE: The eighty-eight foot length is used to simplify calculations since eighty-eight feet per minute is equal to one mile per hour.

c. Thermally stabilize the test item at standard ambient temperature and record the temperature.

d. Warm-up the tractor engine for fifteen minutes prior to testing.

e. Start the tractor run, without trailing load, from point "A".

Ensure that test item is operating in high gear at maximum attainable speed by the time point "B" is passed. Repeat the procedure until five runs have been completed.

f. Record the elapsed time for test item to travel from point "B" to point "C".

g. Perform the procedures of steps e. and f. for rearward direction.

h. Attach the rated trailing load to the test item and perform the procedures of steps e. and f. (Do not attempt reverse testing of speed with a loaded test item).

6.2.2.4 Fuel Consumption Test

Perform applicable procedures of MTP 2-2-603.

6.2.2.5 Turning Radius Test

Determine the minimum turning radius of the test item, by performing the applicable procedures of MTP 2-2-609 and the following:

a. Place the test item on a level, dry, brushed concrete surface.

b. Thermally stabilize the test item at standard ambient temperature.

Record the temperature value.

c. Drive the tractor in full 360 degree turns to the right and to the left. Complete five turns in each direction. Measure the turning radius.

d. Record the turning radius for each trial to the right and left.

6.2.2.6 Gradeability and Side Slope Performance Test

Perform applicable procedures of MTP 2-2-610.

6.2.2.7 Fording Test

Perform applicable procedures of MTP 2-2-612.

6.2.2.8 Mobility Test

Perform applicable procedures of MTP 2-2-619.

6.2.2.9 Endurance and Durability Test

Determine the endurance characteristics of the test item under controlled conditions while undergoing a 720 mile test circuit, by performing the applicable procedures of MIL-STD-259C, and the following:

- a. The test course shall be set up equivalent to the provisions of Appendix A, Outdoor Course for Tractors.
- b. The test course obstacles shall be constructed in accordance with Appendix B, Obstacle Block Construction.
- c. The test course shall be paved with concrete, asphalt, macadam, or equivalent, having a road resistance of 30 to 50 pounds per ton.
- d. During conduct of the endurance test, the course should be dry, clean, and free of snow, ice, non-planned obstacles, or other foreign materials.
- e. Testing shall be accomplished during daylight hours.
- f. The test item shall complete 1440 complete circuits of the test course, with 12 circuits being equivalent to one hour of operation. The test vehicle shall traverse the endurance course at the maximum safe practical speed.
- g. The following shall be accomplished during test item traverse of the endurance course:
 - 1) Lights of the test item shall be illuminated at all times, except at the beginning of each lap when the light switch shall be turned "off" and "on" again.
 - 2) Maintenance and inspections shall be performed in accordance with the draft technical manual or after completion of each 480 test course circuits.
 - 3) A trailing test load shall be connected to the test item for the complete 1440 circuits except for maintenance and when negotiating the obstacle blocks.
 - 4) At the beginning of each lap, the operator shall sound the horn for one second.
 - 5) The test item ignition switch shall be turned off and on after each 12 (one hour) circuits.
 - 6) On alternate days, the endurance test course shall be traversed in the opposite direction.
- h. At the completion of the required number of circuits, the test item should be given routine inspection and service in accordance with the draft technical manual. A record of this inspection shall be kept; an example of a post-test inspection record form is provided by Figure 1.

NOTE: For each item listed vertically by Figure 1, five possible inspection/action outcomes are listed horizontally:
(1) Item OK, (2) Item Not OK, (3) Adjust, (4) Repair, and (5) Replace. Therefore, if outcome (2) is indicated, there should be a corresponding check of (3) or (4), or (5), as appropriate.

6.2.2.10 Broadband Radio Interference Test

Subject the test item to appropriate procedures of MIL-STD-462.

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FIGURE 1: POST-TEST INSPECTION FORM

INSTRUCTION: Examine each item below in sufficient detail to determine any defects or excessive wear which have caused failure in test or might cause failure in normal operation. Place a check mark in column No. 1 or No. 2. If column No. 2 is checked, also check column Nos. 3, 4, or 5.

Description	(1)	(2)	(3)	(4)	(5)
	OK	OK	Not OK	Adjust	Repair
1. Batteries					
2. Brakes					
3. Clutch					
4. Contactors					
5. Cooling - Thermostat					
6. Differential					
7. Drive Axle					
8. Drive Shaft and Universal					
9. Electric Components (Electric tractor)					
a. Battery Blocking					
b. Contactor					
c. Controller					
d. Collector Ring					
e. Foot Pedal Control					
f. Interlock - Controller					
g. Instruments					
h. Limit Switch					
i. Line Breaker					
j. Plug and Receptacle					

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Figure 1: POST-TEST INSPECTION FORM - (Cont'd)

Description	(1) OK	(2) Not OK	(3)	(4) Adjust.	(5) Repair Replace
k. Power Unit (Motors, etc.)					
1. Resistors - Housing					
m. Seat and Brake Switch					
n. Speed Control					
o. Wiring					
10. Engine					
11. Frame and Body					
12. Fuel System (When Furnished)					
13. Automatic Coupler					
14. Instrumentation					
15. Muffler (When Furnished)					
16. Springs					
17. Steering					
18. Transmission					
19. Torque Converter					
20. Wheels					

NOTE: Place remarks opposite the proper number of the following portion of this form. If more space is required, attach separate sheet. Remarks should include details of adjustments, repairs, or replacements indicated by check marks above.

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6.2.2.11 Magnetic Permeability Property Test

Using a suitable magnetometer, measure and record the magnetic permeability properties at a specified fixed distance from all sides of the test item, to determine possible detrimental effects of the test item on aircraft navigation components, e.g. compass. Measurements should be made under the following conditions:

- a. Test item not in operation
- b. Test item engine idling
- c. Test item engine operating at maximum rpm
- d. Generator or compressor operating, if applicable

6.2.3 Transportability Test

With the test item packaged or crated for transport as described in the test item technical manual or manufacturer's instructions, subject the test item to the following transportability tests:

6.2.3.1 Surface Transportability

Subject the test item to the applicable procedures of MTP 10-2-503 less the simulated marine transportability tests.

6.2.3.2 Simulated Marine Transportability Tests

a. Load the test item aboard a suitable ship simulating facility capable of simulating actual ship loading conditions, hold and deck space, and ship's pitch and roll, using normal materiel handling equipment and record the following:

- 1) Ship type simulated
- 2) Equipment used for loading
- 3) Location of storage
- 4) Difficulties encountered loading
- 5) Materials used for securing

b. Apply a roll of 30°, with a period of 30 seconds, and a pitch of 5° with a period of 30 seconds, and a pitch of 5° with a period of 20 seconds for a minimum of one hour and record the following:

- 1) Pitch and roll period
- 2) Accelerometer recording readings
- 3) Damage to test item or bracing

6.2.3.3 Air Transportability Tests

NOTE: The conduct of air transportability testing shall be coordinated with the appropriate unit conducting the air transportability tests.

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Determine and record the internal air transportability of the test item as described in the applicable sections of MTP 7-2-515.

6.2.3.4 Logistics-Over-the-Shore (LOTS)

Determine the LOTS characteristics of the test item as described in the applicable sections of MTP 2-2-520 and the following:

a. Load the test item and a suitable towing vehicle aboard a landing craft from a ship anchored offshore using normal ships handling equipment, couple the test item to the towing vehicle, and record the following:

- 1) Sea state and duration
- 2) Wind direction and speed
- 3) Equipment used for loading
- 4) Difficulties encountered loading or coupling
- 5) Materials used for securing
- 6) Damage to test item or towing vehicle

b. Transport the test item to the shoreline, off-load and tow through sea and surf up to 20 inches, including vehicle-sinkage depth and wave height, for a minimum of 15 minutes. Tow the test item over the sand to a point not less than two miles from the shoreline, and then disassemble, inspect and setup for normal operation. Determine the optimum tire pressures for both the test item and the towing vehicle and record the following:

- 1) Water depth.
- 2) Difficulties in towing.
- 3) Test item and towing vehicle tire pressures.
- 4) Any deficiencies in operation or damage to the components of the test item.

c. Secure the test item for transport, tow it to the shoreline and reload it onto the landing craft by both driving and backing into the craft. Record any difficulties encountered in reloading or damage to the test item.

6.2.4 Maintenance

Evaluate the maintenance-related factors of the test item as described in MTP 2-2-503 with emphasis on the following:

- a. Organizational (O), Direct Support (F), and General Support (H) Maintenance requirements.
- b. Operator through General Support Maintenance Literature.
- c. Repair parts.
- d. Tools.
- e. Test and handling equipment.
- f. Calibration and maintenance facilities
- g. Personnel skill requirements.
- h. Maintainability.
- i. Reliability.

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j. Availability.

6.2.5 Safety

Evaluate the safety characteristics of the test item in accordance with the MTP 2-2-508 and MTP 10-2-508 and record the following, if applicable.

- a. Any dangerous or unsafe condition or any condition that might present a safety hazard including the cause of the hazard and steps taken to alleviate any such hazard.
- b. Inadequate or inoperative safety features.
- c. Adequacy of warning instructions and markings.
- d. Suggestions to improve the existing safety precautions.

6.2.6 Human Factors Evaluation

Evaluate the test item to determine the degree to which test item physical design and revealed performance characteristics conform to recognized human factors engineering design criteria, by performing the applicable procedures of MTP 2-2-803 and the following:

a. Using the criteria of Human Factors Evaluation Data for General Equipment (HEDGE) for Class 11A equipment, prepare check lists to evaluate the human factors characteristics in the following areas.

1) Controls and indicators:

- a) Location: How easy to operate and read
- b) Markings: Clearly marked for function

- 2) Ease of operating and controlling test item.
- 3) Performance characteristics which do not conform to recognized human factors design criteria.
- 4) For maintenance:

- a) Ease of locating malfunctions and determination of cause
- b) Access to defective component
- c) Ease of replacement and/or repair of malfunction

b. Evaluation of the tasks of step a, shall include, but not be limited to, the following:

- 1) Adequacy of furnished instructions
- 2) Ease of performing tasks
- 3) Human factors design deficiency revealed by particular test
- 4) Time to perform task
- 5) Personnel required for task

c. Record inadequacies of the test item design affecting ease of vehicle operation.

d. Ascertain noise levels utilizing criteria prescribed in HEL

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Standard S-1-63B, TB MED 251 and MIL STD 1472.

e. Record any recommendations to improve man-item effectiveness.

6.2.7 Value Analysis

Throughout all tests, the test item shall be examined for any unnecessary, costly, or "nice-to-have" features as described in USATECOM Regulation 700-1 by performing the following:

a. During operation of the test item, observe for features which could be eliminated without compromising performance, reliability, durability, or safety.

b. Question test personnel regarding features of the test item which could be eliminated without decreasing the functional value of the test item or decrease man-item effectiveness.

c. Record the following:

- 1) Non-functional, costly, or "nice-to-have" features of the test item.
- 2) Test personnel comments and opinions regarding features to be eliminated.

6.3 TEST DATA

6.3.1 Preparation for Test

6.3.1.1 Initial Inspection

Record the following:

a. Data collected or described in applicable sections of MTP 2-2-502.
b. Evidence of damage or deterioration of test item or materials used for protection during shipment.

c. Identification markings which were not in accordance with MIL-STD-129, MIL-STD-130, or test item detail specification.
d. Evidence of defects in:

- 1) Manufacturing
- 2) Material
- 3) Workmanship

6.3.1.2 Inventory Check

Record the following:

- a. Missing maintenance literature or draft technical manual(s).
- b. Shortages in repair parts, accessories, or tools.
- c. Missing kits.
- d. Missing parts, tools, or other components of the maintenance package.

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6.3.1.3 Inspection and Preliminary Operation

Record the following:

- a. Data collected as described in applicable section of MTP 2-2-502.
- b. Data collected as described in applicable section of MTP 2-2-505.

6.3.1.4 Pre-Test Evaluation

6.3.1.4.1 Reciprocating Internal Combustion Engine Tests -

Record data collected as described in the applicable sections of MTP 2-2-700.

6.3.1.4.2 Power Train Component Tests -

Record data collected as described in the applicable sections of MTP 2-2-703.

6.3.1.4.3 Tire Tests -

Record data collected as described in the applicable section of MTP 2-2-704.

6.3.1.5 Physical Characteristics

Record the following:

a. Data collected as described in the applicable section of MTP 2-2-500 including the following:

- 1) Engine make and model
- 2) Test item length, less coupler(s), in inches
- 3) Width, in inches
- 4) Height, less cab, in inches
- 5) Wheelbase, in inches
- 6) Ground clearance, in inches
- 7) Governed speed, in miles per hour
- 8) Gross vehicle weight, in pounds

b. Counterweight information.

c. Drive-steer provisions.

d. Aircraft service facilities provided (starting compressor, generator, etc.)

e. Safety equipment supplied.

f. For center of gravity.

- 1) Vertical distance in inches from drive axle
- 2) Horizontal distance in inches from drive axle

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6.3.1.6 Operator Training and Familiarization

Record data collected as described in MTP 10-2-501.

6.3.2 Test Conduct

6.3.2.1 Subsystem Tests

6.3.2.1.1 Clutch Pedal Test -

Record the following:

- a. Test site temperature at time of test, in degrees F.
- b. Maximum force required to depress the clutch (engine not running), in pounds.
- c. Maximum force required to depress the clutch pedal, (engine on), in pounds.
- d. Characteristics of clutch pedal operation which differed with engine running.

6.3.2.1.2 Steering Wheel Test -

Record the following:

- a. Data collected as described in the applicable sections of MTP 2-2-609.
- b. Temperature at time of test, in degrees F.
- c. Maximum gauge reading at extreme end of clockwise steer range, in pounds.
- d. Maximum gauge reading at extreme end of counterclockwise steer range, in pounds.
- e. Following application of specified force to steering mechanism with steerable wheel(s) locked, list any damage or evidence of failure/permanent deformation:

- 1) Force applied clockwise
- 2) Force applied counterclockwise

- f. Number of turns of the hand steering wheel to move the steer wheels from one extreme position to the other.

6.3.2.1.3 Brake Tests -

Record data collected as described in the applicable sections of MTP 2-2-608 and the following:

- a. Test site temperature, in degrees F.
- b. For the service brakes:

- 1) End of the vehicle to which the dynamometer is attached (front, rear).

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- 2) Brake force required to produce specified dynamometer tension, in pounds.
- 3) Measurements, just as wheels of the test item start to turn:
 - a) Tension on the dynamometer
 - b) Force applied to brakes, in pounds
 - c) For the parking brakes:
 - 1) Tension produced on the dynamometer
 - 2) Force applied to brakes, in pounds
 - 3) Adequacy of parking brakes

6.3.2.1.4 Electrical System Tests -

Record data collected as described in the applicable sections of MTP 2-2-601.

6.3.2.1.5 Cooling System Tests -

Record data collected as described in the applicable sections of MTP 2-2-607.

6.3.2.1.6 Exhaust System Tests

Record data collected or described in the applicable sections of MTP 2-2-614.

6.3.2.1.7 Accessory Tests -

a. Lifting Attachment Test - Record the following:

- 1) Test item weight (test item only), in pounds.
- 2) The test item weight with only rear wheels on the scale, in pounds.
- 3) Horizontal perpendicular distance from the center of the rear lifting eye to the vertical plane passing through the center of the front lifting eye, in inches.
- 4) Horizontal perpendicular distance from center of the front lifting eye to the vertical plane passing through the axis of the front wheels, in inches. (When this distance is forward of the lifting eye record as positive, and negative when distance is to the rear of the eye).
- 5) Following application of the test force, list any evidence of damage to the lifting eye(s) and the points where connection is made to the test item.

b. Kit Evaluation - Record data collected as described in the applicable procedures of MTP 2-2-707.

c. Personnel Heating and Ventilation System Evaluation - Record data collected as described in the applicable sections of MTF 2-2-708.

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- d. Winch Evaluation - Record data collected as described in the applicable sections of MTP 2-2-712.
- e. Generator Test - Record data collected as described in the applicable sections of MTP 9-2-136.
- f. Compressor Test - Record data collected as described in the applicable sections of MTP 9-2-166.
- g. Stowage - Record data collected as described in the applicable sections of MTP 2-2-802.

6.3.2.1.8 Power-Train Test -

Record data collected as described in the applicable sections of MTP 2-2-605.

6.3.2.2 Overall Tractor Performance Tests

6.3.2.2.1 Drawbar Pull Test -

Record data collected as described in the applicable sections of MTP 2-2-604 and the following:

- a. Test site temperature at time of test, in degrees F.
- b. Barometric pressure, in inches of Hg.
- c. Test site altitude, in feet above sea level.
- d. Maximum drawbar pull value attained, in pounds.
- e. Test team comments regarding test item and reasons for not attaining required drawbar pull, when applicable.

6.3.2.2.2 Acceleration-Acceleration Response Test -

Record data collected as described in the applicable sections of MTP 2-2-602 and the following:

- a. Acceleration distance (A-B), in feet and inches.
- b. Time required for test item to traverse A-B, for each run, in seconds.
 - 1) Without load
 - 2) Pulling rated load
- c. Test item acceleration response time, fully loaded, in seconds.
- d. Test item acceleration response time, not loaded, in seconds.

6.3.2.2.3 Speed Test -

Record data collected as described in the applicable sections of MTP 2-2-602 and the following:

- a. Test site temperature at time of test, in degrees F.

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b. Elapsed time for test item to traverse an eighty-eight foot interval at maximum speed, in seconds:

- 1) In the forward direction
 - a) With no load
 - , b) With towed load
- 2) In the reverse direction

6.3.2.2.4 Fuel Consumption Test -

Record data collected as described in the applicable sections of MTP 2-2-603.

6.3.2.2.5 Turning Radius -

Record data collected as described in the applicable sections of MTP 2-2-609 and the following:

- a. Test site temperature, in °F
- b. Test item turning radius:
 - 1) To the right
 - 2) To the left

6.3.2.2.6 Gradeability and Side Slope Performance Test -

Record data collected as described in the applicable sections of MTP 2-2-610.

6.3.2.2.7 Fording Test -

Record data collected as described in the applicable sections of MTP 2-2-612.

6.3.2.2.8 Mobility Test -

Record data collected as described in the applicable sections of MTP 2-2-619.

6.3.2.2.9 Endurance and Durability Test -

- a. Record data collected as described in the applicable sections of MTP 2-2-506.
- b. Retain completed Post-Test Inspection Forms.

6.3.2.2.10 Broadband Radio Interference Test -

Record data collected as described in the applicable procedures of MIL-STD-462.

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6.3.2.2.11 Magnetic Permeability Property Test -

Record the following:

a. Magnetic permeability properties on all sides of the test item:

- 1) With the test item not in operation
- 2) With the test item idling
- 3) With the engine operating at maximum rpm
- 4) With the generator or compressor operating, if applicable

b. The distance at which measurements were made, in feet

6.3.2.3 Transportability Test

6.3.2.3.1 Preparation for Test -

Record data collected as described in the applicable sections of MTP 10-2-503.

6.3.2.3.2 Land Tests -

Record highway transportability data collected as described in the applicable sections of MTP 10-2-503.

6.3.2.3.3 Marine Tests -

Record the following:

- a. Ship type simulated
- b. Equipment used for loading
- c. Location of storage
- d. Difficulties encountered loading
- e. Materials used for securing
- f. Pitch and roll period, in seconds
- g. Accelerometer recording readings, in G's
- h. Damage to test item or bracing

6.3.2.3.4 Air Transportability Tests -

Record data collected as described in the applicable sections of MTP 7-2-515.

6.3.2.3.5 Logistics-Over-the-Shore (LOTS) -

Record the following:

- a. Data collected as described in the applicable sections of MTP 2-2-520.
- b. During loading:

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- 1) Sea state (1, 5, etc.) and duration, in seconds
 - 2) Wind direction and speed, in knots
 - 3) Equipment used for loading
 - 4) Difficulties encountered loading or coupling
 - 5) Materials used for securing
 - 6) Damage to test item or towing vehicle
- c. During off-loading and towing operations:
- 1) Water depth, in inches.
 - 2) Difficulties in towing.
 - 3) Test item and towing vehicle tire pressures, psi.
 - 4) Any deficiencies in operation or damage to the components of the test item.
- d. During reloading operations:
- 1) Difficulties encountered reloading
 - 2) Damage to the test item

6.3.2.4 Maintenance

Record data as collected as described in the applicable sections of MTP 2-2-503.

6.3.2.5 Safety

Record data collected as described in the applicable sections of MTP 2-2-508, MTP 10-2-508 and the following:

- a. Any condition that might present a safety hazard
- b. Cause of the hazard
- c. Steps taken to remedy the hazard
- d. Inadequate or inoperative safety features
- e. Adequacy of warning instructions and warnings
- f. Suggestions to improve the man-item effectiveness

6.3.2.6 Human Factors Evaluation

a. Record data collected as described in the applicable sections of MTP 2-2-803 and the following:

- 1) Inadequacies of the test item design affecting ease of vehicle operation.
- 2) Noise levels which exceed the safe limit as described in TB-MED 251.
- 3) Suggestions to improve the existing safety precautions.

b. Retain completed HEDGE checklists.

6.3.2.7 Value Analysis

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Record the following:

- a. Non-functional, costly, or "nice-to-have" features of the test item.
- b. Test Personnel comments and opinions regarding features to be eliminated.

6.4 DATA REDUCTION AND PRESENTATION

Data obtained during conduct of the engineering tests shall be summarized, making use of curves, charts, photographs, or other graphic materials, as appropriate.

Data obtained for each test item performance characteristic shall be compared with technical performance characteristics specified in applicable QMR's, SDR's, or other development criteria.

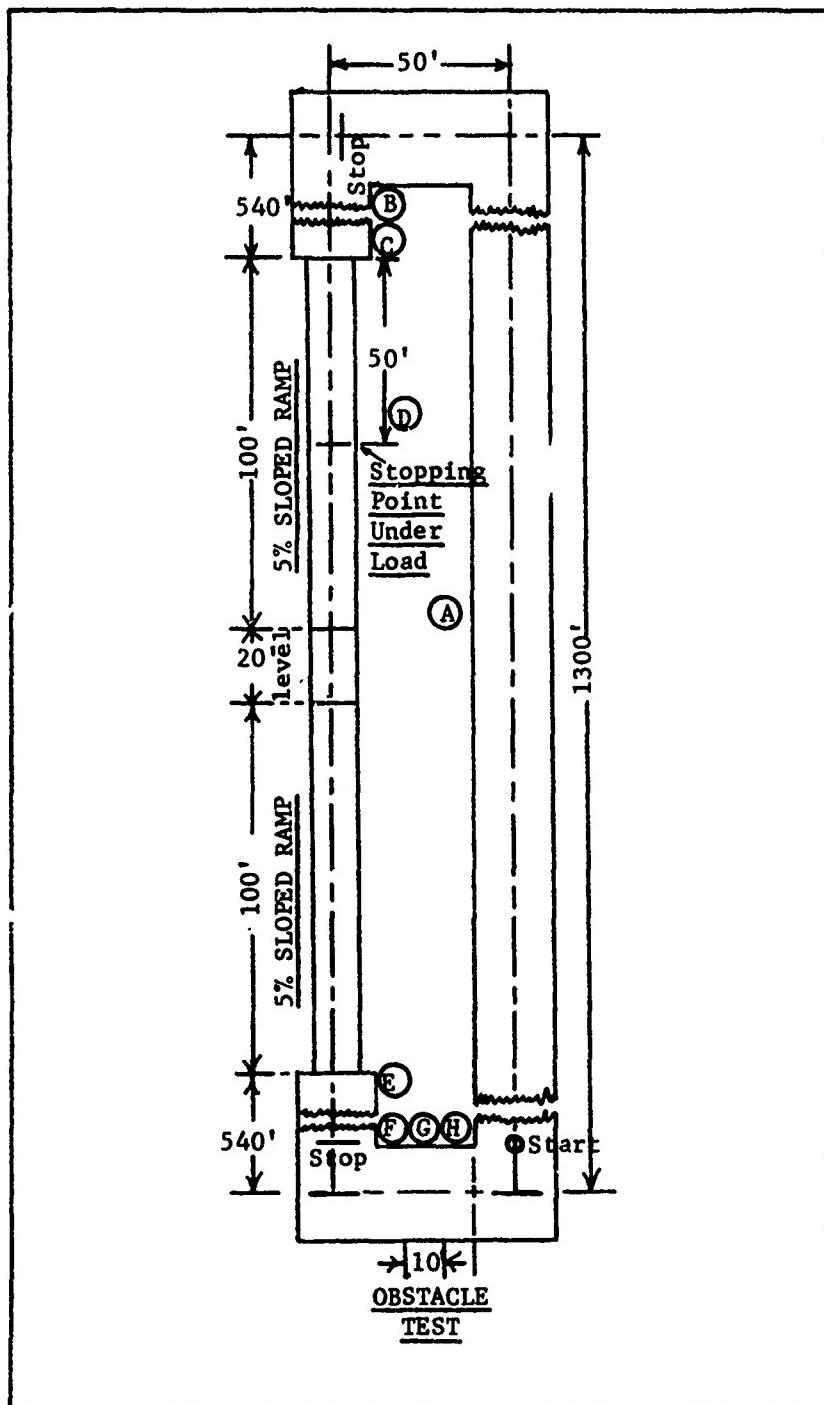
In addition, the data presentation shall include written, narrative reports on all tests specified by this document.

A Safety Release Recommendation shall be submitted in accordance with USATECOM Regulation 385-6 based on the data collected, related to safety.

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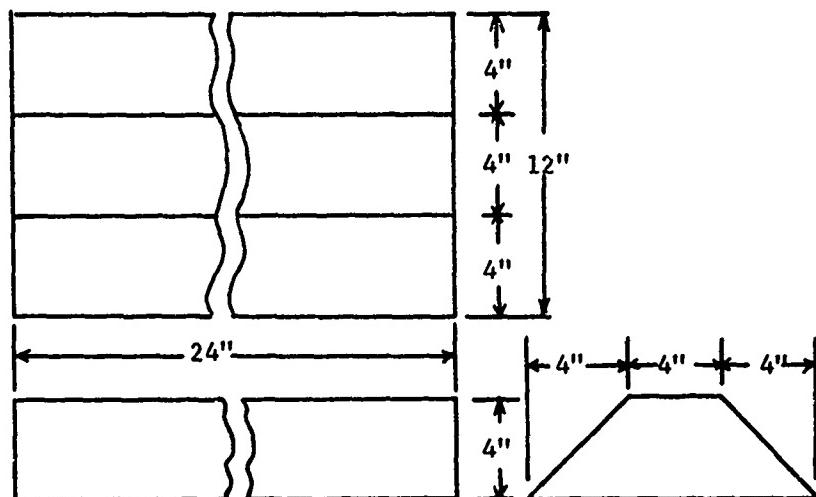
APPENDIX A

ENDURANCE AND DURABILITY TEST COURSE DESIGN

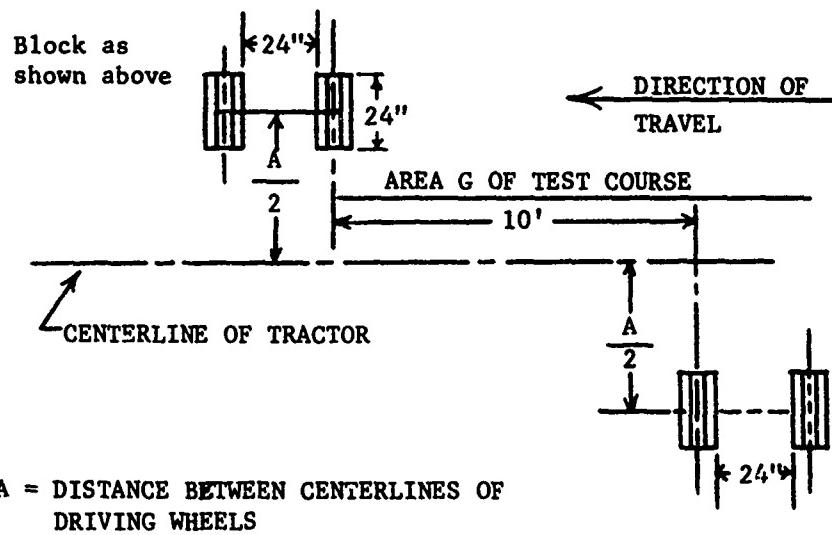


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OBSTACLE BLOCK CONSTRUCTION



LAYOUT OF OBSTACLE COURSE



OBSTACLE BLOCK CONSTRUCTION & LAYOUT

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26 November 1969

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified

1. ORIGINATING ACTIVITY (Corporate author) US Army Test and Evaluation Command (USATECOM) Aberdeen Proving Ground, Maryland 21005	2a. REPORT SECURITY CLASSIFICATION Unclassified	
2b. GROUP -----		
3. REPORT TITLE US Army Test and Evaluation Command Materiel Test Procedure 7-2-105, Commodity Engineering Test Procedure, - "Tractor, Wheeled, Aircraft, Towing."		
4. DESCRIPTIVE NOTES (Type of report and, inclusive dates) Final		
5. AUTHOR(S) (First name, middle initial, last name) -----		
6. REPORT DATE 26 November 1969	7a. TOTAL NO. OF PAGES 34	7b. NO. OF REFS 51
8a. CONTRACT OR GRANT NO. DA-18-001-AMC-1045(R)	9a. ORIGINATOR'S REPORT NUMBER(S) MTP 7-2-105	
b. PROJECT NO. AMCR 310-6	9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) -----	
c.		
d.		
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11. SUPPLEMENTARY NOTES -----	12. SPONSORING MILITARY ACTIVITY Headquarters US Army Test and Evaluation Command Aberdeen Proving Ground, Maryland 21005	
13. ABSTRACT This Engineering Test Procedure describes test methods and techniques for evaluating the technical performance and characteristics of Aircraft Towing Tractors (Wheeled Type) and for determining the suitability of the test item to be subjected to service testing. The evaluation is related to criteria expressed in applicable Qualitative Materiel Requirements (QMR), Small Development Requirements (SDR), Technical Characteristics (TC), and other appropriate design requirements and specifications. () X		

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S/N 0101-807-6811

UNCLASSIFIED

Security Classification

A-31408

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UNCLASSIFIED

Security Classification

14	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	Engineering Test						
	Aircraft Towing Tractor (Wheeled Type)						
	Test Procedures						
	Test Methods and Techniques						

DD FORM 1 NOV 68 1473 (BACK)
S/N 0101-807-6821

UNCLASSIFIED
Security Classification

A-31402